

Appl. No. 10/786,374

Amdt. Dated November 22, 2005

Reply to Office Action of September 6, 2005

AMENDMENTS TO THE SPECIFICATION

Please add the following new paragraphs [0016] and [0017]:

[0016] FIG. 6 is an exemplary valve body that may be implemented into the check valve assembly depicted in FIG. 5; and

[0017] FIG. 7 is an exemplary valve seat that may be implemented into the check valve assembly depicted in FIG. 5.

Please replace paragraph [0020] with the following amended paragraph:

[0020] The gearbox 171 typically includes a plurality of passages (not shown) through which oil freely passes to supply lubrication to the gearbox 171 components. The passages are in fluid communication with oil flow passages within the turbine housing assembly output section 106 via openings 174 (shown in FIG. 2). Preferably, the check valve assembly 176 is placed adjacent or within an opening 174 formed within the starter housing 102. In this embodiment, the check valve assembly 176 is adjacent to the opening 174. ~~[[the]]~~ The check valve assembly 176 operates according to a pressure differential existing between the interior portion of the gearbox 171 and the interior of the ATS 100. Thus, the openings 174 are selectively opened or closed by a check valve assembly 176 depending on the pressure differential.

Please replace paragraph [0029] with the following amended paragraph:

[0029] In another embodiment such as shown in FIG. ~~[[5A]]~~6, the valve body 178 is a two-piece assembly that includes a backing plate 198 upon which the cage 190 is coupled. The backing plate 198 further includes an outer peripheral flange configured to couple to the valve seat 180.

Please replace paragraph [0030] with the following amended paragraph:

Appl. No. 10/786,374

Amdt. Dated November 22, 2005

Reply to Office Action of September 6, 2005

[0030] Referring back to FIGS. 3 and 4, the valve seat 180 has an inlet port 200, an outlet port 202, and channel 184b therebetween. The valve seat inlet port 200 is configured to selectively contact the valve element 182 when the valve is in a closed position. To this end, the inlet port ~~[[180a]]~~ 200 is preferably configured to have a diameter that is smaller than the diameter of the valve element 182. As will be appreciated, the inlet port 200 is preferably circularly shaped, but as will be appreciated, it can be any one of numerous other shapes, depending on the overall configuration of the check valve assembly 176. Thus, in the event of a pressure differential, such as between about .1-.3 psi, between the gearbox 171 and the starter 100 the valve element 182 can tightly seal against the valve seat 180. The valve seat 180 can be constructed of a chemically resistant elastomer or can be constructed to have a precision-machined or precision-ground surface. The outlet port 202 is preferably sized and dimensioned to allow a prescribed flow of oil past the valve element 182 and the valve seat 180 into the starter 100. Optionally, the valve seat 180 can have a sidewall 195 that elongates the channel 184b, as shown in FIG. ~~[[5B]]~~ Z, and is configured to couple with a corresponding portion of the valve body 178 and trap the valve element 182 therebetween.

Please replace paragraph [0031] with the following amended paragraph:

[0031] The valve element 182 is configured to sealingly contact the inlet port 200, thus, the valve element 182 has a surface that can mate with the shape of the inlet port 200. As mentioned above, the shape of the inlet port 200 is preferably circular, accordingly, the shape of the valve element 182 is preferably an orb. Most preferably, the valve element 182 is configured such that the weight of the valve element (F_w) is greater than the sum of the opposing forces that act on the valve element 182 when the valve is in an open position, while the weight of the valve element is less than the sum of the opposing forces when the valve is in a closed position. In other words, it is preferable that the valve element 182 sink to contact the cage 190 when the pressures between the gearbox 171 and starter 100 are equal, and to sealingly contact the valve seat 178 when the pressures between the gearbox 171 and starter 100 are not equal. The opposing forces

Appl. No. 10/786,374

Amdt. Dated November 22, 2005

Reply to Office Action of September 6, 2005

are the buoyant force (F_b) of the element while in the starter 100 or gearbox 171 fluid, the viscous force or drag (F_v) from the fluid flow across the valve element 182, and the pressure force (F_p), which is proportional to the pressure difference between the environment of the gearbox 171 and the starter 100 ($P_{\text{gearbox}} - P_{\text{starter}}$ ~~$P_G - P_S$~~). The aforementioned characteristic can be represented by the following equations:

$$\text{Valve open: } F_w > F_b + F_v + F_p \quad (1)$$

$$\text{Valve close: } F_w < F_b + F_v + F_p \quad (2)$$

Please replace paragraph [0033] with the following amended paragraph:

[0033] Turning to FIG. 3, the check valve assembly 176 is shown while supplying fluid from the gearbox 171 to the starter 100 during normal operation. In this embodiment, normal operation refers to an instance during which the pressure differential between the ATS 100 and gearbox 171 environments is about 0 psi. In a time of normal operation, a pressure differential resulting from the head height of fluid over the inlet port 186 relative to the exhaust port 202 exists, and at least the valve body 178 and valve element 182 are immersed in fluid or oil present between the gearbox 171 and starter 100. Thus, the valve element ~~[[177]]~~ 182 freely translates axially between the valve body 178 and valve seat 180. Oil and/or air passes through the valve body channel 184a and around the outer periphery of the valve element 182, as indicated by arrows 208. Consequently, oil and/or air passes between the ATS 100 and gearbox 171 with little to no restriction.